

PELTI RF04 Flight Report for 15 July, 2000

The objective of this flight was to measure the size distribution of sea salt at several altitudes using each of the inlets and sizing devices. Since we finally had all the TAS parts in hand, we also did a comparison of sodium concentrations with those inferred from the APS and FSSP-300 observations. We did four (4) flight legs of an hour each, with 3 in the MBL and the last in the (slightly dusty) FT. We directed the flight at a region (21N 60W) where relatively high dust concentrations were forecast by the NAAPS model. In fact, however, the dust concentrations were much higher near St. Croix.

1600	Takeoff
	Sounding to 2400 m (Roughly ENE)
1611	Level at 2400 m - LTI Flow/Pressure-drop Leg
1620 - 1634	Sounding down to 30 m in the MBL
	Turn to East
1634 - 1734	Level at 30 m Eastbound Sea Salt Leg
1646:31 – 1734:00	APSs running (flows presumably stable)
	Filters exposed, including TAS w/ Teflon
	Turn to NNE and climb to 900 m
1737:30 – 1742:40	Level at 900 m in moist layer decoupled from surface mixed layer
1743 – 1841	Level at 1060 m to avoid clouds
1748 – 1841	Filters exposed; Teflon in TAS
1750:36 – 1841:22	APSs running
1837:30	Sounding down to 30 m then back up to 90 m, turn back to SSW
1846:30 – 1946:30	Level at 90 m Sea Salt Leg (winds generally <7 m/s)
1847:51 – 1946:30	APSs running
	Filters exposed; Teflon in TAS
1946:30	Turned West and climb to 2000 m
1954:15 – 2054:15	Level at 2000 m Dust Leg
1955:59 – 2054:15	APSs running
	Filters exposed; Nuclepore in TAS
2056:42 – 2106:52	Common-inlet Calibration Leg
2110:50	Descent and Return to STX
2119	Landed

Notes

- The high RH on the 900/1070 m leg will make RH corrections critical for the APSs and nephs. The dew point depression was often 2-3 deg. There was also a substantial gradient of many properties from one end of this leg to the other (less aerosol at the north end).
- It was quite hazy near St. Croix. Evidently the dust was farther south and west than forecast.

- After delaying the flight almost an hour to try to fix a leak around the fitting behind the cabin FSSP, we still noted evidence of a leak into the cabin during flight. The flight was done unpressurized precisely to minimize possible leaks at this spot.
- The DU sample flow computation (from their LFE) still looked unrealistic: changing TFM flows by 100 slpm produced no apparent change in the value on the DU display used to set flows to isokinetic. We made an effort to compensate. Restarting the DU computer sometimes cured the problem.
- Clarke's FSSP was put on the wing again, and it once again seemed to have a notch with no counts in channel 9.
- The TAS flows were sometimes about 10% below isokinetic, apparently due to the gradual failure of its Gast 1550 pump. It will be replaced for the next flight.
- According to Lynn Russell, there were lots of small salt particles on the 90 m leg (but no whitecaps), implying a somewhat aged sea salt aerosol.
- A newly-calibrated flowmeter was put in place behind the cabin 300. The cabin and wing FSSP-300s were in very good agreement in the 0.8 – 3 μm range, but the cabin one recorded much higher concentrations at larger sizes.
- As on all flights, the APS behind the LTI showed only slightly higher concentrations than the NASA inlet up to about 3 μm , and considerably higher concentrations above that.

Commentary

This was a very successful test of the three inlets, in which we finally have good TAS data to support tests of the ambient/LTI difference. The FSSPs seem to indicate that the largest-particle concentrations behind the LTI are enhanced by a factor of several relative to ambient. When the filter and TAS data is worked up, we will see how reliable the FSSP difference is. The APSs again indicated that the LTI admits more large particles than any of the other three inlets. What we still lack is a variety of sea salt and dust concentrations with which to test the ability of the LTI to pass various distributions of each. Filter data from RF03 has now been analyzed, and show the same thing as the APSs: when the air is dry, the NASA solid diffuser inlet is only slightly less efficient than the LTI (95% of the LTI soluble Ca in a FT dust layer), while in the wetter MBL particles that impact on the walls of a solid diffuser are more likely to stick (45% of the LTI soluble Ca). The bounce of dry particles from inlet walls works to improve the performance of traditional inlets in the dry FT.

One issue we will have to resolve in the lab and with computer models is the nature of the secondary peak on the right of the LTI APS distributions. We had assumed that it was due to enhancement by curving streamlines in the LTI, but a couple of pieces of evidence put that in question. The first is the change in the secondary peak during the 2000 m dust leg, while the main peak remained relatively constant. That suggests there actually are two populations, which Jim Anderson says is not uncommon in dust. Also, Jeff Reid reports FSSP volume-median diameters of 7-9 μm from his Navajo flights. That is where the secondary peak shows up in the APS data. This story is not resolved yet, but the SEM analyses will also help to do so.

-Barry Huebert
17 July, 2000